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ABSTRACT

The Multimedia Forum Kiosk (MFK) is an on-line discussion tool that has been tested as a new technique for assessing curricular reform. MFK collects discussion comments entered into the computer by students and instructors. This paper explores experiences with the MFK as a technique for on-line assessment using multimedia. The context of the assessment is an eight-university coalition of engineering schools called Synthesis, which is sponsored by the National Science Foundation. In this study, the MFK assessment approach was used to document community-wide reactions to aspects of curricular innovation, to foster discussion about new pedagogical practices, and to sample student skills and attitudes that could be demonstrated in an engineering discussion. The MFK allows discussion in an opinion area allowing for one statement of opinion and a discussion area that allows for exchanges of comments. Face icons of all the participants in the discussion made their identities salient and gave discussions a more personal tone. In this context, the MFK was very fruitful in examining curricular reform, a situation in which goals were vague and not based on declarative knowledge. By involving the instructors in conversations with their students, the MFK facilitated the evaluation of curriculum impact. Capturing discussions is a viable way to examine processes and attitudes and a new tool for open-ended assessment. (Contains 1 table, 1 graph, and 10 references.) (SLD)

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On-line Multimedia Assessment of Curricula: Experiences with the Multimedia Forum Kiosk

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Introduction:

The Multimedia Forum Kiosk (MFK) [Berman, Hsi, & Hoadley, 1994; Berman, Hsi, Hoadley, & Linn, 1995; Hoadley & Hsi, 1992] is an on-line discussion tool that has been tested as a new technique for assessing curricular reform. MFK collects discussion comments entered into the computer by students and instructors. Preliminary data suggests the multimedia interface of MFK encourages productive discussion and reflective comments [Hoadley & Hsi, CHI 1993] and can be effective for encouraging group communication, full participation, and collaborative knowledge building [Hsi & Hoadley, AERA 1994].

This paper shares our experiences with the Multimedia Forum Kiosk as a new technique for on-line assessment using multimedia. We focus on three key aspects of the Kiosk, and we present examples from engineering to demonstrate how the tool supports group assessment and capitalizes on the multimedia nature of the electronic medium.

Motivation: Assessment of Curricula

The context of our assessment is an eight university coalition of engineering schools called Synthesis. Sponsored by the National Science Foundation, the coalition's goals are to improve undergraduate engineering education and to better prepare engineering students for the workplace. This is being achieved

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through modifying existing curricula, developing multimedia courseware, testing new instructional methods, and inventing new technology-based solutions to instruction. [NSF EEC, 1990].

Assessing curricular reform poses interesting challenges. First, instructors in the process of developing and refining educational materials to meet general pedagogical goals have difficulty measuring the impact of their changes. Oftentimes, a problem in the curriculum or in student outcomes is perceived, but it is not always clear what would be better, or even what the criteria of improvement would be. Instructors sometimes don't know in what direction their curriculum should be changed.

Second, a challenge in assessing curricular reform is that the purpose of reform often addresses both global and local concerns. In our case, global concerns included producing engineers who are better at communicating, synthesizing information, and negotiating in the marketplace. These concerns must be kept in mind while local objectives such as teaching students a specific engineering analytic approach are also being met. An assessment method needs to be flexible to capture students' reactions to both local and global aspects of changes to the curricula and to instruction.

Thirdly, curricular reform often focuses on non-declarative aspects of learning. For instance, one goal of the Synthesis Coalition is higher retention of women and ethnic minorities in engineering. Unlike traditional content areas, assessing the curricular impact on retention involves a complex interplay of social mores, attitudes, and long-term behavior, none of which is easily captured in a course test. Another example would be Synthesis' emphasis on skills for teamwork. By nature, these skills are not demonstrable in a traditional hour-long written test.

To address these needs, the Multimedia Forum Kiosk assessment approach had the following objectives: (a) to document community-wide reactions to aspects of curricular innovations, (b) to foster dialogue and discussion about new pedagogical practices, and (c) to sample student skills and attitudes which could be demonstrated in an engineering discussion (such as a design discussion). In doing so, the system would complement more outcome-based

measures of curricular success, such as test scores or employment rates. The system filled three important gaps left by traditional classroom testing: collection of student opinions of the new instruction, an appropriate way for students to contribute to the curricular evolution, and a way of gauging how students interact with each other.

Brief Description of the System

The Multimedia Forum Kiosk allows two types of discussion in two different areas: The *Opinion Area* and the *Discussion Area*. (Figure 1 and Figure 2) In the Opinion Area, students type in their overall reaction to a topic phrased as a question. Each topic has an author, typically the instructor, who introduces the topic with a text overview. Users can read the overview provided by the instructor, watch digital movies, read about the stances of others, or post their own viewpoint. For instance, a topic might be "Which of these experiences has helped you become a better engineer?" and could be accompanied by images of activities from the course, links to other documents such as homework assignments, or video clips of a student discussing an extracurricular experience. Each comment is represented by a face icon, so the identity of the contributor is immediately obvious; on the other hand, students may remain anonymous and choose a cartoon icon if they wish not to be identified (if they are being critical of the instructor, for example). Each person may give only one opinion in the Opinion Area, much like voting on an issue. These responses are open-ended, however, and may be edited at a later date to reflect changes in the student's stance. Open-ended responses allow students to decide what aspects of the curriculum to mention and to explain their answers in as much detail as necessary. Students may glance at the screen and see who is participating in the discussion, then discover their opinion on the topic at the click of a mouse. As a collection, the comments in the Opinion Area serve as the community perspective on the topic theme.

The second representation of discussion is called the Discussion Area. The Discussion Area allows users to make multiple comments, and to respond to the comments of others. This allows an ongoing, back-and-forth type of discussion. Each comment in the Discussion Area is categorized according to the semantic labels (AND, BUT, OR, I.E., ?, ...) and linked to a previous

comment to form argument *trees*. Students may respond at any time to any comment made in the past. This representation lends itself to following lines of reasoning, tracing previous discussions, and (for the researcher performing assessment) analyzing comments.

The Multimedia Forum Kiosk is currently implemented in Hypercard 2.2 with QuickTime for the Apple Macintosh. It includes an authoring toolkit which allows instructors to design topics easily. (see Figure 3) Currently we are reimplementing the system to allow networked access via the World Wide Web.

How was MFK used? A Description of an Evaluation

Identifying Themes

The first step in the MFK assessment approach was to meet with instructors to identify central themes to investigate. In the context of our assessment of engineering education, we arrived at four themes chosen to also reflect the Synthesis objectives: (1) relevance to engineering practice, (2) Synthesis learning experiences, (3) classroom learning atmosphere, and (4) design learning and instruction (Table 1). These themes not only structured the discussion topics used for evaluation, but also helped to organize the data analyses.

Identifying Topics

For each course, several topics were designed by instructors with the help of evaluators that were consistent with the four assessment themes. For instance, some sample topics are presented here from two mechanical engineering courses.

> **What are some effective ways to teach design?**
> Case-base advocates of learning believe that students learn by studying many examples of good design. Others believe in the brute force approach where students gain experience through building as many prototypes as possible in the studio or shop. Do you agree with these viewpoints? What are other methods you have used to learn engineering design?

Is your classroom or lab a supportive environment for learning?
The classroom, like a design environment, can greatly affect a student's ability to learn. It is important to provide an environment that fosters learning and exploration. The instructor and students should be both listeners and active participants. Do you feel this is the case for ME290P?

What do you think you are learning in ME107A?
In ME107A, we try to teach you general principles of experimentation that every engineer should know. What do you think you are learning in 107A versus what you think we are trying to teach you?

ME107A: Guided learning or trial and error?
Are the107A labs more like guided learning or like trial and error? As instructors, we want to encourage you to use your engineering judgment in planning an experiment. At the same time, we know this is the first time you've seen this hardware. Would you like more detailed instructions on lab procedures, or do you like the freedom to plan your own experiment?

Students were given from one week to one 15 week semester to respond to a set of topics. Typically, an MFK was set up in a location where students could access the conversation at their convenience, such as a course laboratory. Students who want to voice opinions about new curricular materials, the learning atmosphere, or instructional delivery could interact with the Kiosk during the semester either voluntarily or as an assigned independent activity.

During the course evaluation period, comments and discussion were automatically logged by the computer. Instructors could read the comments interactively, or print out hard copies to keep a record of student feedback.

Why Group Assessment?

A feature of the Multimedia Forum Kiosk assessment approach is its ability to capture comments collaboratively and share them in a group. Unlike surveys that are collected at the end of the semester and read by the instructor only, in the MFK students share the responsibility of motivating others to comment and motivating others to have a voice. Because each person's comment is made public to peers in the course, students who may be insecure or lacking in confidence are likely to become more comfortable in engineering courses when they find that the concerns that they have are shared by others. Group

assessment using MFK provides an immediate opportunity for ideas to be debated among the community of students and allows instructors to weigh the comments of students in light of how they react to each other's suggestions.

Table 1. Themes and Sample Questions for an MFK Evaluation

A. Relevance to Engineering Practice - students perception about importance of current education and impact on future employment and success in engineering, open-ended problem solving, application of theory, analyses, technical excellence, social and communication skills, teamwork
B. Learning Experiences - activities in class are relevant to learning, comparing synthesis courses with non-synthesis courses, learning environment, hands-on, access to new technology, multiple delivery formats, multidisciplinary exposure
C. Class Atmosphere - students' opinions about class environment, ability to find help, camaraderie, comfort with gender and ethnic issues, receptiveness to learning styles, supportive/hostile environment for engineering success
D. Open-ended Problem Solving/Design - opportunities for hands-on design, creativity, learning about concurrent engineering, design for X, solving original problems best way to learn design, opportunity for creativity, concepts applicable to new problems, concurrent engineering, DFX, linking coursework to design tasks

Another feature of group assessment is that it is interactive. If a student raises a point which is not well understood by the instructor, the instructor (or another student) can probe further, asking for clarification or elaboration. Likewise, if a student critiques or questions some aspect of the course, the instructor is free to explain his or her rationale for the course design. If new ideas are introduced, all have the opportunity to discuss them; compare this to, for instance, a course evaluation survey in which a student response to one item might suggest additional items for the survey.

Assessment in a group also allows individual students to define him/herself with respect to others to establish a role. The nature of discussion is to take

positions, and students who agree or disagree with each other will naturally highlight these similarities and differences in their conversations.

Why On-line Assessment?

The Multimedia Forum Kiosk allows comments to be collected on-line: automatically and electronically. The advantage of creating an electronic record of all comments and interactions made by users is that data are easy to collect. Moreover, instructors can receive immediate feedback by reading students' responses interactively or review the feedback by reading comments compiled into a text file. This allows instructors to modify their courses and better tailor them to students' needs *during* instruction, rather than in the following semester as is typical of feedback from course evaluation surveys.

Although MFK creates a permanent electronic record of all comments entered along with the time and date of their creation, students who revise their thinking on a topic can update their overview comments at any time. This feature captures both the process by which students think about different issues as well as their resulting knowledge of the issue.

Another advantage of on-line assessment is that every individual can participate in the discussion at their own pace which is often not possible in panel review or face-to-face discussion. We have had great success in bringing cultural and linguistic minorities into the conversation because they may read, write, and revise contributions at their own pace. The asynchronous nature of a Kiosk discussion allows individuals to participate in a many-to-many discussion, but enter the discussion as one-to-many. In other words, each student has the time and space to have a voice. Additionally, individuals can choose to make anonymous comments, allowing less vocal and less confident students a role in the discussion.

Asynchronous discussion also provides time for individual reflection. For instance, these representative comments demonstrate the quality of comments that MFK is able to capture among university students.

**Opinion Area: Designing & generating concepts in groups: help or hindrance?

It really depends on the members of the brain storming group. If you have a very dominant team member in the brain storming group shooting down people's ideas, causing fixations and preventing context switch, concept generating in a group can be a disaster. As far as I am concerned, they (in a group) did not generate more brilliant ideas than my individual effort.

Designing in groups may be a hindrance for those who are afraid of being ridiculed or judged. I found that the best teams, whether design or whatever, work well because they have broken down barriers between the members. An understanding and respect for individuality exists between the members and they can work effectively together.

Before working together as a group you have to learn how to cooperate, how to work creatively. The design fixation experiment, and the reports are a very good way to learn team work from one's own mistakes and the mistakes of the others. The best way to create ideas would be, that at first each team member should think about the problem for his own. At the next day there should be a meeting where the ideas are discussed.

** Opinion Area: What are some effective ways to teach design?

I think that effective teaching for design or any other subject should consist of using many teaching methods such as hands on experience (industry experience), lecture, discussion, reading, etc. Because students have different preferred learning styles (i.e. some learn best by experimenting, some by reading), a multitude of teaching methods will help all the students learn.

It occurred to me that engineering programs, unlike those in fine arts or architecture, do not have gut-wrenching critiques and juries. These are highly instructional and formative activities necessary in the teaching of these disciplines. Would this approach be helpful in engineering?

**Discussion Area: What are some effective ways to teach design?

It seems to me that case studies cannot really be said to convey the design process as it happens very well. They give the highlights, and these can be learned from, but learning how something was done is not the same as doing that thing.

True. Maybe a deeper evaluation of a design using the case study as a guide would be more helpful than just reading and discussing the case study itself. Adding hands-on experience to the case study.

One learns by doing. As Tod said, the ability to design requires practice at designing. You can't learn how to juggle, or drive a car, or ride a bike by simply watching another perform it. As with any other skill, design requires practice.

But without some background, the first few months you will be groping without any direction.

It would also be useful to see examples of bad design. Especially if one didn't know what the good/bad aspects of a design were until after the analysis had been performed.

Why Multimedia/Hypermedia Assessment?

Multimedia features were used in two different ways on the Kiosk. First, face icons of all participants of the discussion made identities salient. This allowed discussion to take on a more personal tone since participants were reminded that real people were behind each comment. A second feature of multimedia was the use of images, computerized documents, and digital movies as discussion stimulus materials. Multimedia (especially video) was used specifically to bring engineering examples into the discussion, to link examples of curricula students had been experiencing in the course, or to import personal stories and add a more human feel to the topic. We included interviews with engineers from industry, replayable simulations, and

interviews with engineering students at other campuses discussing the same issues. These images and videos were often more poignant and more effective at starting discussion than vague, depersonalized references in text.

Analysis: purposes and strategies

As mentioned above, the MFK system was intended to fill gaps left by other methodologies. In the courses we worked with, other assessment strategies included student surveys, grades and tests, portfolios, and analysis of videotapes of student activities. Our method succeeded at providing effective, formative evaluation of curricular changes to the instructors. The methodology proved to be of much lower cost than detailed methodologies such as video interaction analysis (Jordan and Henderson, 1995), and more informative than simple methods such as student evaluation surveys. It also proved to be able to capture non-traditional outcomes such as attitudes and strategies for collaborative work where traditional assessments such as tests, grades, and even portfolios sometimes failed.

Our primary goals in our analyses were to 1) offer informal, timely feedback to course instructors, 2) to capture information related to our predetermined themes, and 3) to identify good and bad aspects of the curricular reform that were not captured in our themes. We hoped to provide rich examples that explained and supported other methodologies.

Analysis with respect to the first goal, timely feedback, was accomplished by having instructors participate in discussions and summarize issues raised in the Kiosk during their lecture time. Summaries of the discussions were also provided to the instructors, who would often share these with instructors of other courses. At least one instructor made major changes in the course outline for their course midstream due to feedback received through the Kiosk.

Analysis with respect to the second goal, information on specific themes, was achieved by classifying each comment in every topic according to which of the themes they addressed. Within themes, categories were created for types of responses. For instance, in the "learning experiences" theme comments

were categorized according to the specific learning method discussed (multimedia presentations, case studies, design projects, etc.) and the student's response to the curriculum in that area, where possible. In addition, some analysis of the discourse processes proved illuminating for our themes as well. For instance, we tallied comments-per-person ratios and proportions of comments made anonymously in order to gain insight into "classroom atmosphere". We found large differences between classrooms, with instructors who were stereotyped as unapproachable or harsh generating large proportions of anonymous comments. Interestingly, anonymous comments and critical comments were not one and the same, with most students signing their criticisms in certain courses, while many students made even positive comments anonymously in other courses. (see Figure 4) This may support the use of anonymity as a measure of comfort in the classroom atmosphere.

Our third goal of identifying ideas outside of our planned analysis was also a success. In summarizing the discussions for the instructors, we identified issues which had been raised but that were not captured in our themes. Students felt comfortable raising these ideas. For instance, in one course students raised points about the organization of their course. Even though none of our topics specifically addressed course organization, many students took the opportunity the Kiosk presented to complain about these problems. These same issues were raised in course evaluations later on. Other students commented on topics ranging from the character of their particular college town to the problems faced by non-native English speakers at a university.

We did preliminary cross-validation of the Kiosk method by comparing the summary reports generated with course evaluations performed on a standardized survey. Where non-thematic issues were raised in the MFK and incorporated into the summary, we checked against the standardized survey to see if any of the questions applied to that issue. Where they did, we examined the survey results for that question in that particular course. In every case, results for the course differed from the baseline in the way predicted by the Kiosk summary.

Currently, work is underway to use the structure of Kiosk discussions to measure scientific inquiry and science conceptions in a middle school science course. We believe that the Kiosk will continue to provide rich data sources for various types of analyses and assessments, from the informal and casual to the highly rigorous.

Conclusions

In summary, computer discussion tools can provide a useful platform on which to base assessments of curricular changes. In our case, the Multimedia Forum Kiosk proved especially fruitful in examining curricular reform, where goals were vague and not based on declarative knowledge. By involving the instructors in conversations with their students, the impact of curricular changes on students was readily felt and fed the process of reform. Capturing discussions is a viable way to examine processes and attitudes, and electronic discussion tools with multimedia fill an important niche in open-ended assessment methodologies.

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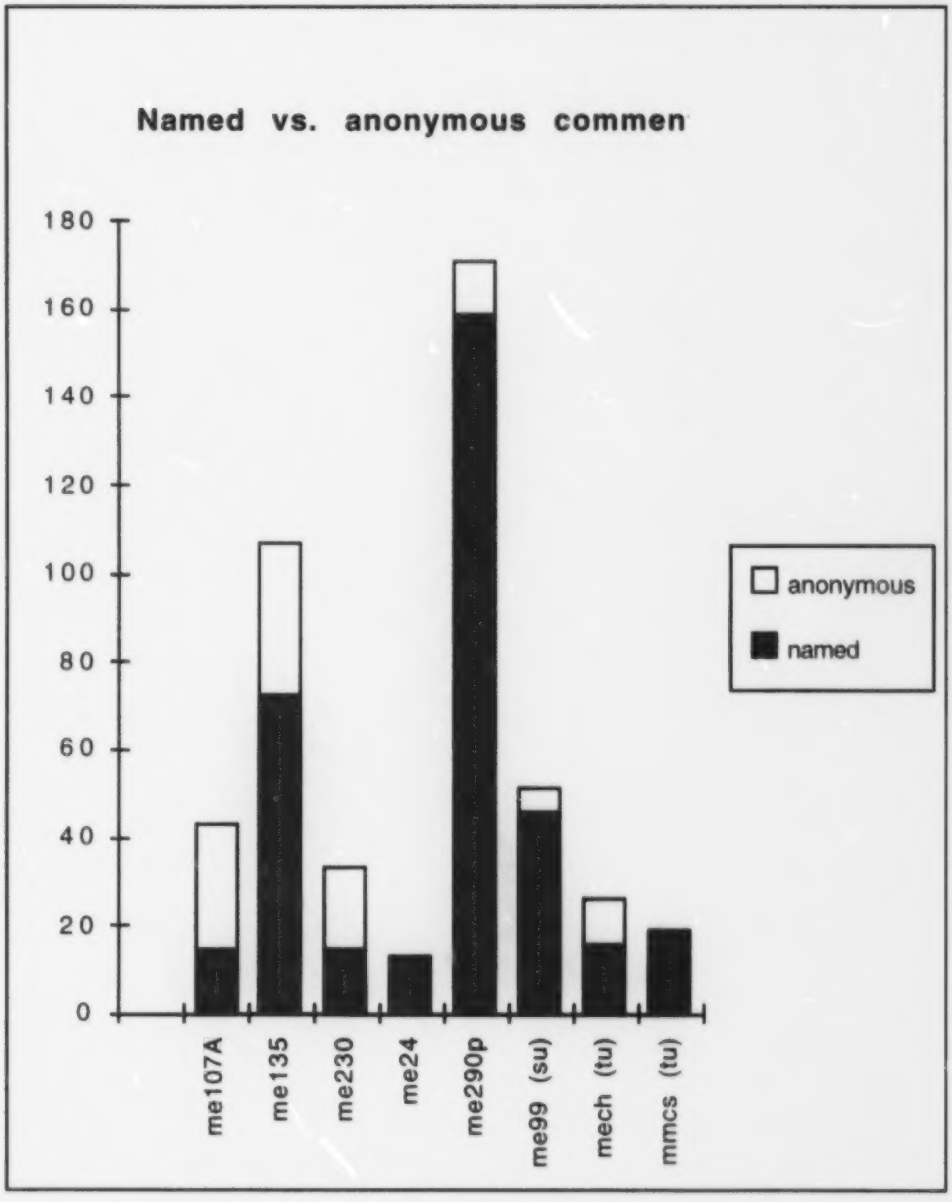

Figure 4: Comparison of anonymous vs. named comments in MFK evaluation of different engineering courses